

Amendments to the Claims

Please amend Claims 1, 3, 7, 11, 13, 15, 22-26, 28, 36, 38, 40 and 48-54. Please add new Claims 55-66. The Claim Listing below will replace all prior versions of the claims in the application.

Claim Listing

1. (Currently Amended) A method of measuring fullness of a cryopump that evacuates a processing volume comprising:
 - coupling a total pressure gauge in direct fluid communication with an inner vacuum region behind a condensing surface distinct from an outer vacuum region outside the condensing surface, the inner vacuum region including an adsorbent for adsorbing non-condensable gases in a cryopump;
 - during processing or recovery from processing cycles, measuring pressure of the inner vacuum region with the pressure gauge, the measured pressure being substantially less than the pressure in ~~[[an]]~~ the outer vacuum region outside of the condensing surface;
 - and
 - determining an adsorption capacity of the adsorbent using the measured pressure.
2. (Original) A method as in Claim 1 wherein the pressure gauge is an ion gauge.
3. (Currently Amended) A method as in Claim 1 wherein coupling the pressure gauge in fluid communication with the inner vacuum region includes connecting the pressure gauge to a tube or duct leading to the ~~in the~~ inner vacuum region.
4. (Previously Presented) A method as in Claim 1 further including adsorbing gases at the condensing surface, the adsorbed gases consisting substantially of non-condensable gases.
5. (Previously Presented) A method as in Claim 4 wherein non-condensable gases include at least one of hydrogen, helium or neon.

6. (Previously Presented) A method as in Claim 1 wherein the inner vacuum region behind the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
7. (Currently Amended) A method as in Claim 1 wherein the [[the]] inner vacuum region further includes an array of baffles coated with an adsorbent.
8. (Previously Presented) A method as in Claim 1 wherein the cryopump further includes first and second stage arrays cooled by a refrigerator, the second, colder stage further including the condensing and adsorbing surfaces.
9. (Original) A method as in Claim 8 wherein a partial pressure of hydrogen inside the second stage array is lower than a partial pressure of hydrogen outside the second stage array.
10. (Previously Presented) A method as in Claim 1 wherein determining an adsorption capacity of the adsorbent using the measured pressure further includes determining whether the adsorbent has reached its adsorption capacity using the measured pressure.
11. (Currently Amended) A method as in Claim [[8]] 10 wherein the determining an adsorption capacity of the adsorbent using the measured pressure ~~further~~ includes determining an adsorption capacity for non-condensable gases based on the measured pressure.
12. (Previously Presented) A method as in Claim 1 wherein determining an adsorption capacity of the adsorbent using the measured pressure further comprises determining a residual adsorption capacity of the cryopump using the measured pressure.
13. (Currently Amended) A cryopump comprising:
 - a closed cycle refrigerator;
 - a condensing surface cooled by the refrigerator;
 - a total pressure gauge in direct fluid communication with an inner vacuum region,
the pressure gauge sensing pressure, during processing or recovery from the processing

cycles, in [[an]] the inner vacuum region behind the condensing surface distinct from an outer vacuum region outside the condensing surface, the inner vacuum region including an adsorbent; [[and]]

the sensed pressure being substantially less than the pressure in an outer vacuum region outside of the condensing surface; and

an electronic controller determining an adsorption capacity using the measured pressure.

14. (Original) A cryopump as in Claim 13 wherein the pressure gauge is an ion gauge.
15. (Currently Amended) A cryopump as in Claim 13 wherein the pressure gauge is connected to a tube or duct leading to the ~~in the~~ inner vacuum region behind the condensing surface.
16. (Previously Presented) A cryopump as in Claim 13 wherein gases are adsorbed within the condensing surface, the adsorbed gases consisting substantially of non-condensable gases.
17. (Previously Presented) A cryopump as in Claim 16 wherein the non-condensable gases include at least one of hydrogen, helium or neon.
18. (Previously Presented) A cryopump as in Claim 13 wherein the inner vacuum region behind the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
19. (Previously Presented) A cryopump as in Claim 13 further includes first and second stage arrays cooled by the refrigerator, and the second, colder stage further including the condensing and adsorbing surfaces.
20. (Original) A cryopump as in Claim 19 wherein the condensing surface of the second, colder stage further includes:

a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to and in close thermal contact with a heat sink on the second, colder stage.

21. (Original) A cryopump as in Claim 19 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.
22. (Currently Amended) A cryopump as in Claim 20 ~~further comprising an~~ wherein the electronic controller further includes ~~which measures pressure with the pressure sensor;~~ ~~the controller including~~ computer program instructions which determine whether the adsorbent has reached its adsorption capacity based on the measured pressure.
23. (Currently Amended) A cryopump as in Claim 22 wherein the controller ~~further~~ includes instructions to determine an adsorption capacity of the cryopump for non-condensable gases based on the measured pressure.
24. (Currently Amended) A cryopump as in Claim 13 ~~further comprising an~~ wherein the electronic controller ~~which measures pressure with the pressure sensor; the controller including~~ further includes computer program instructions which determine a residual adsorption capacity for the condensing surface using the measured pressure.
25. (Currently Amended) A system for measuring fullness of a cryopump that evacuates a processing volume comprising:

[[a]] means for coupling a total pressure gauge in direct fluid communication with an inner vacuum region behind a condensing surface distinct from an outer vacuum region outside the condensing surface, the inner vacuum region including an adsorbent for adsorbing non-condensable gases in a cryopump;

[[a]] means for measuring pressure of the inner vacuum region with the pressure gauge during processing or recovery from processing cycles, the measured pressure being substantially less than the pressure in [[an]] the outer vacuum region outside of the condensing surface; and

[[a]] means for determining an adsorption capacity of the adsorbent using the measured pressure.

26. (Currently Amended) A method of measuring fullness of a cryopump that evacuates a processing volume comprising:

connecting a total pressure gauge in direct fluid communication with an inner vacuum region enclosed by cryopumping surfaces distinct from an outer vacuum region outside the condensing surface, the cryopumping surfaces including an adsorbent for adsorbing non-condensable gases;

during processing or recovery from processing cycles, measuring pressure of the inner vacuum region with the pressure gauge, the measured pressure being substantially less than the pressure in [[an]] the outer vacuum region; and

determining an adsorption capacity of the adsorbent using the measured pressure.

27. (Original) A method according to Claim 26 wherein the pressure gauge is an ion gauge.

28. (Currently Amended) A method according to Claim 26 wherein connecting the pressure gauge in fluid communication with the inner vacuum region includes connecting the pressure gauge to a tube or duct leading to the ~~in the~~ inner vacuum region.

29. (Previously Presented) A method according to Claim 26 further including adsorbing gases at the cryopumping surfaces of the cryopump, the adsorbed gases consisting substantially of non-condensable gases.

30. (Previously Presented) A method according to Claim 29 wherein the non-condensable gases include any of hydrogen, helium or neon.

31. (Previously Presented) A method according to Claim 26 wherein the inner vacuum region enclosed by cryopumping surfaces has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.

32. (Original) A method according to Claim 26 wherein the cryopumping surfaces further include an array of baffles coated with an adsorbent.

33. (Previously Presented) A method according to Claim 26 wherein the cryopump further includes first and second stage arrays cooled by a refrigerator, the second, colder stage further including condensing and adsorbing surfaces.
34. (Original) A method according to Claim 33 wherein a partial pressure of hydrogen inside the second stage array is less than a partial pressure of hydrogen outside the second stage array.
35. (Previously Presented) A method according to Claim 26 wherein determining an adsorption capacity of the adsorbent using the measured pressure further comprises determining whether the adsorbent has reached its adsorption capacity using the measured pressure.
36. (Currently Amended) A method according to Claim 35 wherein determining an adsorption capacity of the adsorbent using the measured pressure ~~further~~ includes determining an adsorption capacity for non-condensable gases based on the measured pressure.
37. (Previously Presented) A method according to Claim 26 wherein determining an adsorption capacity of the adsorbent using the measured pressure further comprises determining a residual adsorption capacity of the cryopumping surfaces using the measured pressure.
38. (Currently Amended) A cryopump comprising:
a cooled condensing surface coated with an adsorbent for adsorbing non-condensable gases; ~~[[and]]~~
a total pressure gauge in direct fluid communication with an inner vacuum region behind a condensing surface, the pressure gauge sensing pressure during processing or recovery from processing cycles in [[an]] the inner vacuum region enclosed by the condensing surface distinct from an outer vacuum outside of the condensing surface, the sensed pressure being substantially less than the pressure in an outer vacuum region outside the condensing surface; and

an electronic controller determining adsorption capacity of the adsorbent using the measured pressure.

39. (Original) A cryopump according to Claim 38 wherein the pressure gauge is an ion gauge.
40. (Currently Amended) A cryopump according to Claim 38 wherein the pressure gauge is connected to a tube or duct leading to the ~~in the~~ inner vacuum region enclosed by the condensing surface.
41. (Previously Presented) A cryopump according to Claim 38 wherein the adsorbent is used to adsorb gases, the adsorbed gases consisting substantially of non-condensable gases.
42. (Previously Presented) A cryopump according to Claim 41 wherein the non-condensable gases include at least one of hydrogen, helium or neon.
43. (Previously Presented) A cryopump according to Claim 38 wherein the inner vacuum region enclosed by the condensing surface has a pressure which is at least one order of magnitude less than a process chamber coupled to the cryopump.
44. (Previously Presented) A cryopump according to Claim 38 further includes first and second stage arrays cooled by the refrigerator, and the second, colder stage further including the condensing and adsorbing surfaces.
45. (Original) A cryopump according to Claim 44 wherein the condensing surface of the second, colder stage further includes:
a second stage cryopanel surrounded by a radiation shield, the cryopanel having an array of baffles coated with an adsorbent, the baffles being coupled to and in close thermal contact with a heat sink on the second, colder stage.

46. (Original) A cryopump according to Claim 45 wherein a partial pressure of hydrogen inside the second, colder stage is less than a partial pressure of hydrogen outside the second, colder stage.
47. (Previously Presented) A cryopump according to Claim 38 further comprising an electronic controller which measures pressure with the pressure sensor, the controller including computer program instructions which determine whether the adsorbent has reached its adsorption capacity based on the measured pressure.
48. (Currently Amended) A cryopump according to Claim 46 wherein the ~~controller further includes instructions~~ [[to]] determine an adsorption capacity for non-condensable gases based on the measured pressure.
49. (Currently Amended) A system for measuring fullness of a cryopump that evacuates a processing volume comprising:
[[a]] means for connecting a total pressure gauge in direct fluid communication with an inner vacuum region enclosed by cryopumping surfaces distinct from an outer vacuum region outside the cryopumping surfaces, the cryopumping surfaces including an adsorbent for adsorbing non-condensable gases;
[[a]] means for measuring pressure of the inner vacuum region with the pressure gauge, the measured pressure being substantially less than the pressure in an outer vacuum region; [[and]]
[[a]] means for monitoring an adsorption capacity of the adsorbent using the measured pressure; and
means for determining that the adsorption capacity of the adsorbent has been reached by detecting, using the measured pressure, a rise in pressure during recovery.
50. (Currently Amended) A method as in Claim 1 wherein the pressure ~~sensor~~ gauge measures the pressure of non-condensable gases without sensing the cryopump total pressure.

51. (Currently Amended) A cryopump as in Claim 13 wherein the pressure ~~sensor~~ gauge measures the pressure of non-condensable gases without sensing the cryopump total pressure.
52. (Currently Amended) A method ~~[[as in]]~~ according to Claim 26 wherein the pressure gauge measures the pressure of non-condensable gases without sensing the cryopump total pressure.
53. (Currently Amended) A cryopump ~~[[as in]]~~ according to Claim 38 wherein the pressure gauge measures the pressure of non-condensable gases without sensing the cryopump total pressure.
54. (Currently Amended) A cryopump ~~[[as in]]~~ according to Claim 38 ~~further comprising an wherein the~~ electronic controller ~~which measures pressure with the pressure sensor, the controller including~~ further includes computer program instructions ~~that which~~ determine a residual adsorption capacity for the condensing surface using the measured pressure.
55. (New) A method as in Claim 10 wherein determining an adsorption capacity of the adsorbent using the measured pressure further includes determining that the pumping capacity has been reached if a rise in pressure during recovery is detected.
56. (New) A method as in Claim 55 wherein the rise in pressure during recovery is detected when there is a rise in pressure behind a second stage array to about 5×10^{-6} torr.
57. (New) A method as in Claim 10 wherein determining an adsorption capacity of the adsorbent using the measured pressure includes:
 predicting a residual pumping capacity of the cryopump; and
 communicating the predicted pumping capacity to the host control system.
58. (New) A cryopump as in Claim 22 wherein the electronic controller including instructions responsive to a rise in pressure during recovery by determining that the cryopump has reached its pumping capacity.

59. (New) A cryopump as in Claim 58 wherein the rise in pressure during recovery is detected when there is a rise in pressure behind the second stage array to about 5×10^{-6} torr.
60. (New) A cryopump as in Claim 22 wherein the electronic controller further including instructions for responding to a rise in pressure during recovery by:
 - predicting a residual pumping capacity of the cryopump; and
 - communicating the predicted pumping capacity to the host control system.
61. (New) A method according to Claim 35 wherein determining whether the adsorbent has reached its adsorption capacity using the measured pressure includes determining that the pumping capacity has been reached if a rise in pressure during recovery is detected.
62. (New) A method according to Claim 61 wherein the rise in pressure during recovery is detected when there is a rise in pressure behind a second stage array to about 5×10^{-6} torr.
63. (New) A method according to Claim 35 wherein determining whether the adsorbent has reached its adsorption capacity using the measured pressure includes:
 - predicting a residual pumping capacity of the cryopump; and
 - communicating the predicted pumping capacity to the host control system.
64. (New) A cryopump according to Claim 47 wherein the electronic controller including instructions responsive to a rise in pressure during recovery by determining that the cryopump has reached its pumping capacity.
65. (New) A cryopump according to Claim 64 wherein the rise in pressure during recovery is detected when there is a rise in pressure behind the second stage array to about 5×10^{-6} torr.

66. (New) A cryopump according to Claim 47 wherein the electronic controller including instructions responsive to a rise in pressure during recovery that:
- predict a residual pumping capacity of the cryopump; and
 - communicate the predicted pumping capacity to the host control system.